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E70 Steering Column Switch Cluster

Steering Column Switch Cluster

Model: E70

Production: From Start of Production

OBJECTIVES

After completion of this module you will be able to:

- Explain the technology used for the stalk levers
- Understand and identify the different components used in the SZL

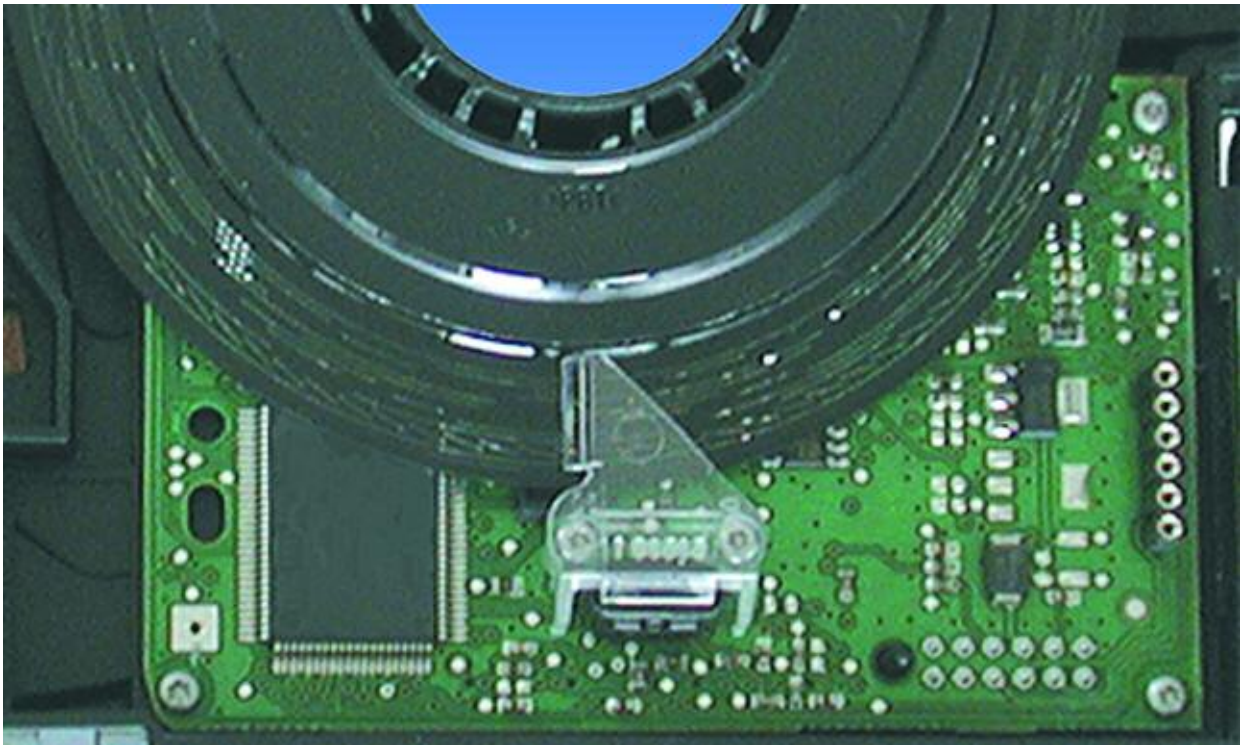
Introduction

A steering column switch cluster SZL is used on the E70 that can detect the steering angle and the settings of the steering column switches for wiper, direction indicator light and cruise control by means of optical sensors.

In addition to the optical sensors, buttons based on switching-mat technology are used for the buttons on the multifunction steering wheel and various buttons on the steering column stalks. The voltage signals are read by the steering column switch cluster.

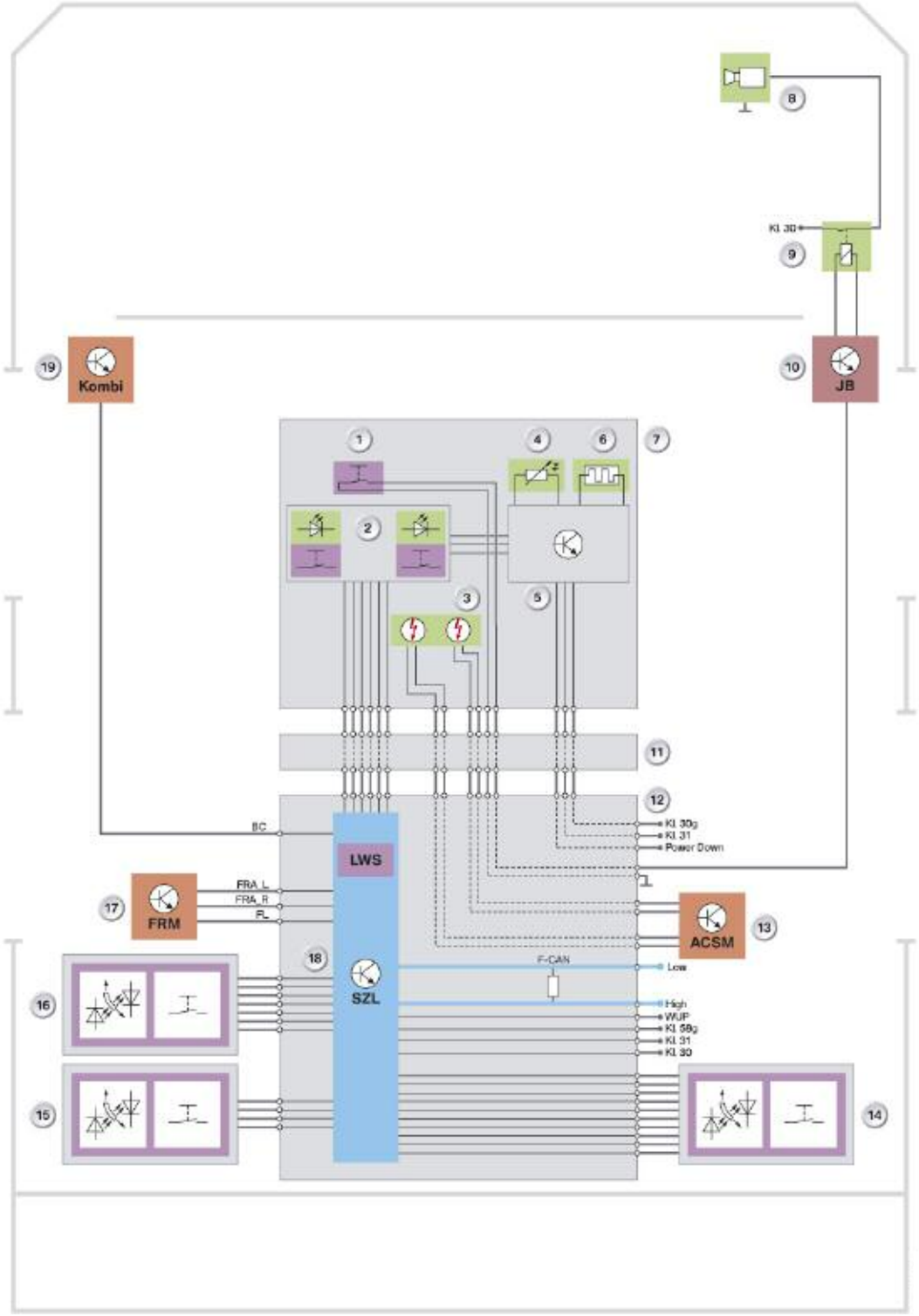
The information from the switches and steering angle sensor are in part processed in the steering column switch cluster and transferred to other systems via the F-CAN. A part of the information is forwarded directly to other control units.

Note: In terms of design and function, the steering column switch cluster essentially corresponds to the steering column switch cluster on the E90. A new feature is the electronic steering wheel module that is responsible for controlling the steering wheel heating.



System Overview

System Circuit Diagram



Legend for System Circuit Diagram

Index	Explanation	Index	Explanation
1	Horn switch	17	Footwell module FRM
2	Multifunction steering wheel	18	Control unit for steering column switch cluster
3	2-stage driver airbag	19	Instrument cluster KOMBI
4	Temperature sensor for steering wheel heating	BC	On-board computer
5	Electronic steering wheel module	F-CAN	Chassis CAN
6	Steering wheel heating	FL	High beam
7	Steering wheel	FRA_L	Direction indicator light, left
8	Horn	FRA_R	Direction indicator light, right
9	Horn relay	KI. 30	Terminal 30
10	Junction box control unit	KI. 30g	Terminal 30 switched
11	Coil spring assembly	KI. 31	Terminal 31
12	Housing of steering column switch cluster	KI. 58g	Terminal 58g
13	Advanced crash safety module ACSM	LWS	Steering angle sensor
14	Steering column switch, wipers	Power Down	Command from the IHKA control unit to shut down or reduce the electronic steering wheel module
15	Steering column switch, cruise control	WUP	Wake-up line
16	Steering column switch, direction indicator lights		

System Components

The steering column switch cluster SZL consists of the following components:

- Electronic steering column switch cluster module
- Steering angle sensor
- Steering column switch, cruise control
- Steering column switch, direction indicator stalk
- Steering column switch, wipers
- Coil spring assembly

The steering column switch cluster SZL can only be replaced as a complete unit. The coil spring assembly is fitted on the steering column switch cluster. The coil spring assembly can be removed and individually replaced.

Index	Explanation
1	Steering column switch, direction indicator stalk
2	Steering column switch, cruise control
3	Code disc
4	Steering column switch cluster with optical sensor
5	Steering column wiper stalk with buttons for rain/driving lights/solar sensor

The electronic steering column switch cluster module contains a processor, the power supply and following interfaces:

- F-CAN
- Optical switches
- Electrical switches

The optical sensor for measuring the steering angle is integrated in the pc-board of the control unit.

Sensor System

Steering Angle Sensor

The steering angle sensor is designed as a contactless, optical angle measuring system.

The system consists of a code disc and an optical sensor. The code disc is connected via a drive element directly to the steering wheel.

The code disc turns within the optical sensor when the steering wheel is moved.

Code Disc

The code disc is died black and features a line pattern. This pattern consists of two continuous lines on the outside and inside of the code disc.

Broken lines are located between the two continuous lines at a defined spacing with respect to each other. These lines represent the digital area of the sensor. The digital code changes every 2°.

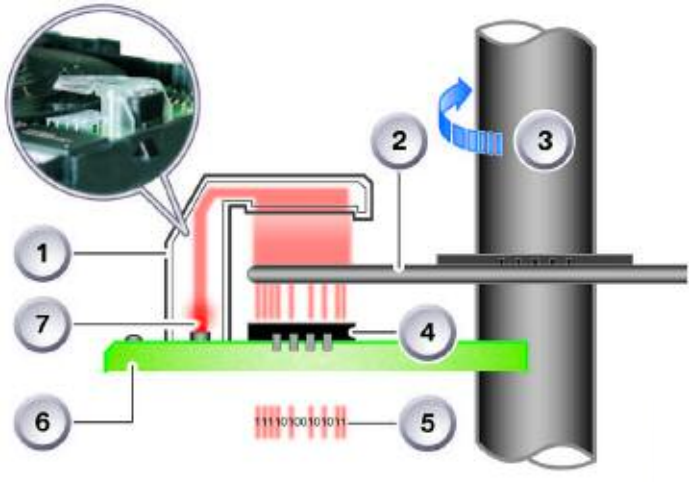
The obliquely arranged lines in the outer area represent the analog area of the sensor.

These lines permit exact measurement (0.1°) of the steering angle.

The steering angle sensor detects the steering angle setting of the steering wheel and is evaluated in the SZL. The information is mainly required by the DSC control unit.

Optical Sensor

The optical sensor is designed as follows.



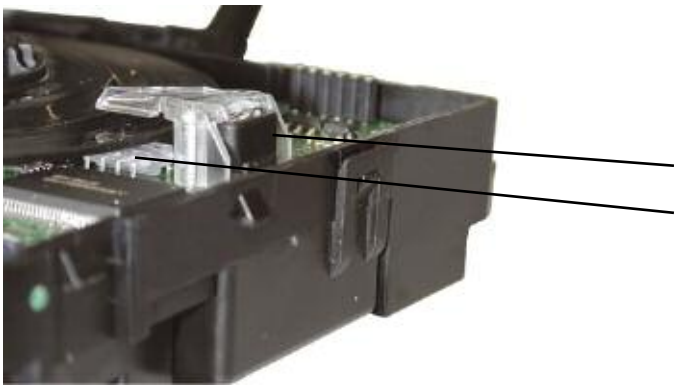
Index	Explanation
1	Fiber Optics Unit
2	Code Disc
3	Steering Column
4	Line Camera
5	Output: Conversion to Electrical Signals
6	PC-Board
7	LED

LED and Fiber Optics Unit

The task of the LED in connection with the fiber optics unit is to project light from the top onto the code disc. The LED is soldered directly to the pc-board of the SZL. The fiber optics unit is secured to the pc-board by means of two screws. Together, the LED with the fiber optics unit and line camera make up the optical sensor.

Line Camera

The line camera is located under the code disc. The line camera converts optical signals that penetrate through the code disc into electrical signals.



Index	Explanation
1	Line Camera
2	Fiber Optics Unit

Steering Column Switches

The positions of all steering column stalks are determined optically. The steering column stalks are mounted such that they can be swivelled and run in a curved path at the lower end of the stalk to define the switching characteristics in the respective positions. The advantage of optical acquisition of the stalk position is that it is possible to precisely determine the pressure point. The spring force of the microswitch need not be taken into account when defining the stalk force required for switching.

Function

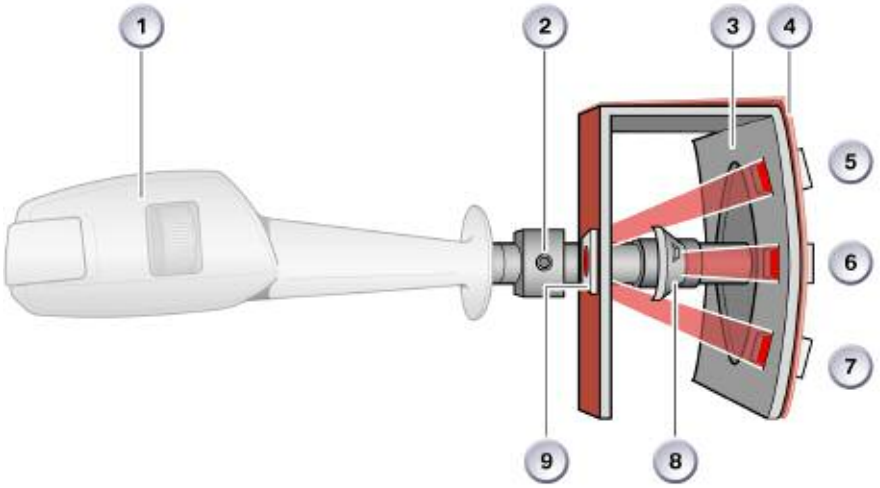
Depending on the type of steering column stalk, there are three or four LEDs on the outside and one optical receiver (light dependent resistor LDR) on the inside of the steering column housing of the steering column stalk. A shutter is provided on the steering column stalk which, when in rest position, is located between the center LED and the LDR. As a result, the shutter blanks out the light of the center LED when in rest position.

As soon as the steering column stalk is moved, the shutter moves up or down. One of the outer LEDs is now covered. The LEDs are never activated together but always clocked one after the other. In this way, the electronic SZL module can detect which LED is currently blanked out. The function can be monitored by measuring the current at the LED.

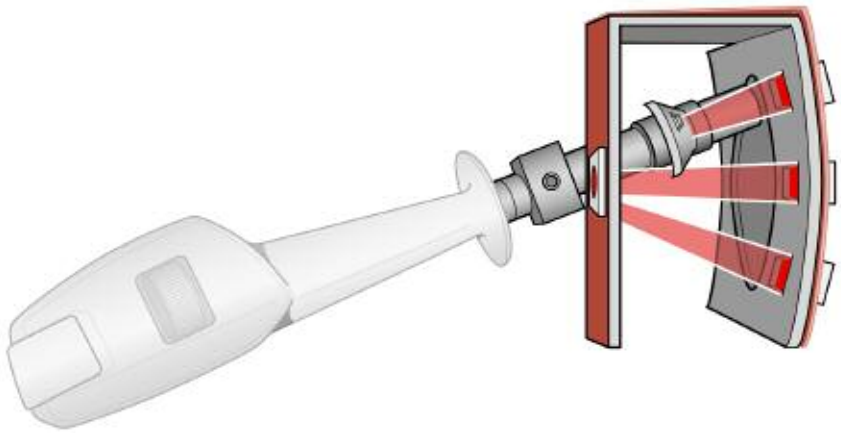
The buttons and thumbwheels in the steering column switches are realized by means of buttons based on switching mat technology. The resulting voltage signals are either routed to the SZL and distributed to the corresponding control units (wiper switch - junction box control unit) or forwarded directly to other control units.

The functional principle of the optical sensors of the steering column switches is represented in simplified form in the graphics below. As the result of vertical movement, the upper diode is blanked out then followed by the center diode. In actual fact, both the horizontal as well as the vertical stalk movement is detected.

Steering Column Stalk in Rest Position



Index	Explanation	Index	Explanation
1	Steering column stalk	5 - 7	LED
2	Pivot point of steering column stalk	8	Cover
3	Retaining fixture	9	Light-dependent resistor (LDR)
4	Conductor		

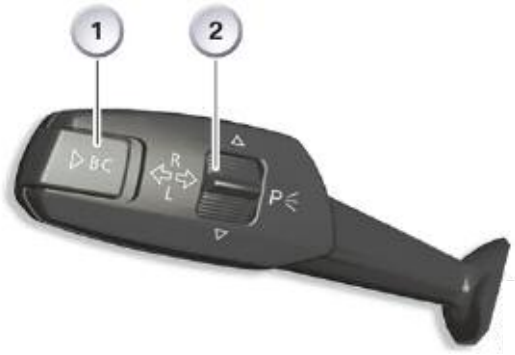


Steering Column Stalk in Operated Position

Steering Column Stalk

High Beam/Direction Indicator Switch

The steering column stalk features the buttons for the on-board computer and the rocker switch for scrolling through the menus of the on-board computer.



Index	Explanation
1	On-Board Computer Button
2	Rocker Switch

Cruise Control

The steering column stalk contains the button for the cruise control. The set speed value can be changed by pushing the stalk forward or pulling it back.

Index	Explanation
1	Rocker Switch
2	Button fro RLSS

Wiper Switch

The steering column stalk contains the button for switching the automatic wipe function ON/OFF with the rain/driving lights/solar sensor.

The sensitivity of the rain/driving lights/solar sensor or the automatic interval can be set with the rocker switch.

Index	Explanation
1	Cruise Control Button

Coil Spring Assembly

The coil spring assembly can be replaced only as a complete unit. The task of the coil spring is to transmit the following electrical signals from and to the multifunction steering wheel:

- Activation of driver airbag
- Control buttons SMG (being prepared)
- Multifunction buttons
- Horn
- Steering wheel heating

Locking

To avoid damaging the coil spring assembly, it must be set to the correct position when dismantling the steering wheel and coil spring assembly.

The front wheels and steering wheel must be set to the straight-ahead position as the prerequisite for disassembly.

During disassembly of the steering wheel, the load on the lock pin of the coil spring assembly is relieved and the pin can lock in the straight ahead position.

When the steering wheel is reinstalled, this arrangement ensures that the coil spring is not damaged when the steering wheel is turned to full left and right lock.

Steering Wheel Heating

The steering wheel heating is controlled by the electronic steering wheel module. The electronic steering wheel module is accommodated in the steering wheel.

Index	Explanation
1	Steering Wheel Heating Button
2	Electronic Steering Wheel Button

The steering wheel heating is activated by means of a switch on the steering wheel. The switch is connected directly to the electronic steering wheel module. The power is supplied via two dedicated connections.

To prevent overloading the electrical system, the function can be deactivated by the IHKA by means of a power-down connection.

Standard Steering Wheel

Sport Steering Wheel

Index	Explanation
1	Steering Wheel Heating Indicator Light
2	Steering Wheel Heating Button

Principles of Operation

The functions of the steering column switch cluster are:

- Detecting switching signals in the steering column switches
- Detecting steering angle and steering speed
- Detecting the controls in the multifunction steering wheel
- Sending and receiving information to/from the interlinked control units

Detecting Steering Angle and Speed

The steering column switch cluster must detect the steering angle and steering speed information as the basis for calculating various functions in the DSC.

Further information such as the absolute steering angle or the steering wheel rotation information is calculated. A steering angle of - 180°/+180° is detected.

An LED and fiber optics unit illuminate the code disc from above. Due to the pattern on the code disc, the light from above reaches the bottom only in certain areas where the light beams hit the line camera.

The line camera converts the line signals into electrical signals and transfers them to the steering column switch cluster.

Relative Steering Angle (±180°)

The relative steering angle indicates the angle position of the steering wheel. The information relating to the relative steering angle is always retained even when power to the control unit is disconnected. Renewed zero point adjustment is necessary only after the steering column switch cluster has been replaced. This requirement also applies when replacing the DSC or performing repairs on the steering/steering column systems.

Absolute Steering Angle

The absolute steering angle is a calculation based on the relative steering angle and steering wheel rotation information. The absolute and relative steering angles are defined during zero point adjustment of the steering column switch cluster. The SZL detects each position of the steering wheel over the entire steering lock range.

The precondition for the zero point adjustment is that the wheels and steering wheel are set in the straight-ahead position.

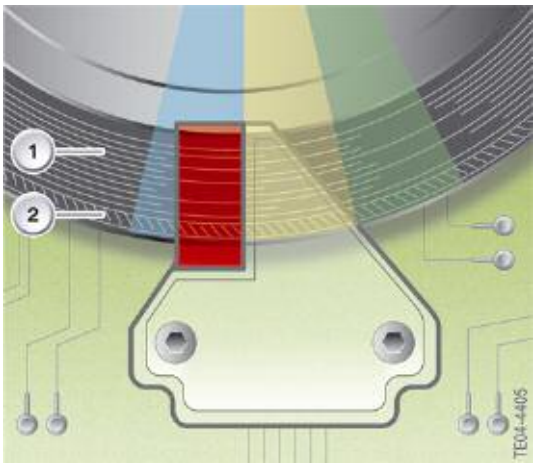
Steering Wheel Rotation Information

The steering wheel rotation information indicates the turn position of the steering wheel.

The steering wheel rotation information is determined automatically by a virtual calculation model.

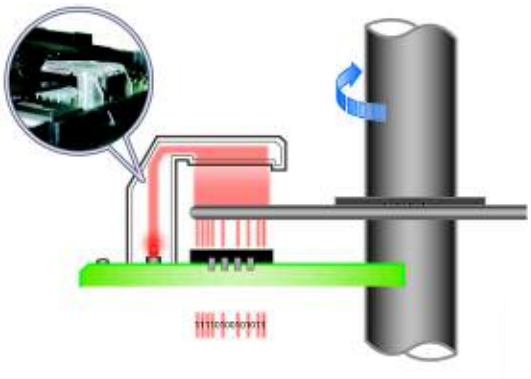
If lost, e.g. if power to the SZL is disconnected, this information must be taught-in again.

Section of Code Disc

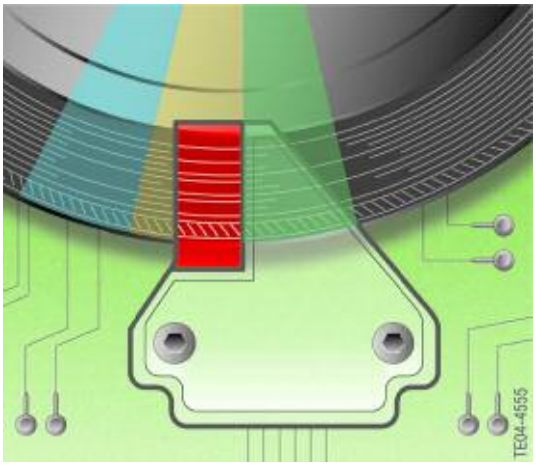


The code disc rotates dependent on the steering wheel angle setting. The pattern on the code disc changes in steps of 2°. A resolution of 0.1° can be achieved for the steering angle sensor by evaluating the linear track.

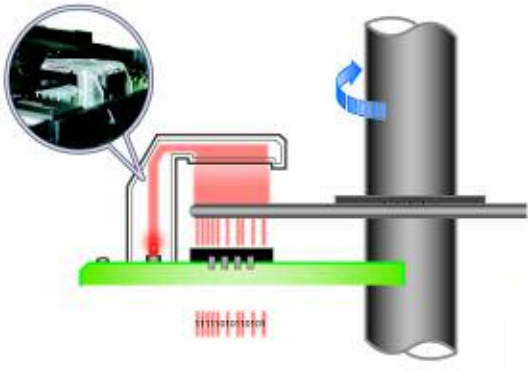
Optical Sensor



The light beams hit the line camera. The light pulses are converted to electrical pulses in the line sensor.



The pattern on the code disc changes as the disc continues to turn. The light passes through the code disc into other areas.



The position of the light beams is displaced. The line camera detects the light beams in other areas and transfers the information to the SZL.

The steering column switch cluster uses data from the speed sensors of the front wheels for the calculation. The SZL assumes the vehicle is driving straight ahead at constant speeds and therefore detects its zero position. The minimum speed necessary for this purpose is 20 km/h. This process need not be initialized via the BMW diagnosis system. The SZL automatically determines the steering wheel rotation information as soon as the vehicle exceeds the minimum speed.

Problems may occur in calculating the steering wheel rotation information under unfavorable road conditions (icy road surfaces). The DSC sends a corresponding check control message in this case.

Detecting the Controls in the Multifunction Steering Wheel

The voltage signals of the buttons on the multifunction steering wheel are routed via the coil spring to the steering column switch cluster. The SZL evaluates the voltage signals and sends the information to the corresponding control units.

The connections of the Steptronic switches, horn and of the driver airbag are wired directly via the coil spring to the corresponding control units. This information is therefore not evaluated in the SZL.

Detecting the Signals of the Steering Column Switches

Optical switches are used in connection with the steering column stalks on the E70. Optical sensors detect the stalk position and make this information available to the steering column switch cluster. Buttons based on switching mat technology are located in the heads of the steering column switches. They transfer voltage signals corresponding to the switch position to the steering column switch cluster SZL.

Note: The operating procedure and the resulting functions are described in the Owner's Handbook.

Direction Indicator/High Beam Switch

The signals of the direction indicator and high beam switch are monitored by the SZL and transferred via three voltage-coded lines to the footwell module. Only information relating to the switch positions is transmitted.

The signals of the on-board computer button and the rocker switch are transferred via a line from the SZL to the instrument cluster.

The functions in the respective switch positions are defined in the control units.

Wiper Switch

The signals of the wiper switch are calculated directly in the steering column switch cluster and transferred via the F-CAN to the DSC and to the junction box.

Cruise Control Switch

The signals from the cruise control switch are routed via the F-CAN to the DSC and further via the PT-CAN to the DME/DDE. The functions are calculated in the engine management.

The signals for the dynamic cruise control DCC or active cruise control ACC systems are made available to the longitudinal dynamics management LDM. Data are sent via the F-CAN to the DSC. From the DSC, the data are placed on the PT-CAN making them available to the longitudinal dynamics management.

Signal Flow

The acquired and calculated data of the steering column switch cluster are mainly transferred via the F-CAN to the corresponding control units.

The information for diagnosis is therefore also transferred via the F-CAN to the DSC. The DSC establishes the communication interface with the BMW diagnosis system.

The steering column switch cluster cannot be addressed directly via the BMW diagnosis system.

The DSC must be encoded after replacing the steering column switch cluster. The DSC transfers the coding to the steering column switch cluster.